As the Anesthesiologist Sees the Sunset

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• *Age need no longer be a barrier to operation in view of the expanding knowledge of the care of surgical patients. Blood volumes and blood components can be maintained with replacement therapy. Nutritional and vitamin requirements are better understood and carbohydrates, proteins and vitamins must be given in sufficient quantities to prevent further debilitation during the critical period following operation.*

It has been suggested that the usual pharmacological effects of drugs may not be applicable to elderly patients. The choice of anesthetic agent based on pharmacological effects on younger persons does not necessarily apply to the aged.

NOWADAYS ELDERLY PERSONS are seen in increasingly large numbers in surgical practice. This has resulted from the increased life span that has come about in the past half century. The number of people in this country 65 years of age or older has already exceeded twelve million and with each year there is a further increase.

Surgical treatment has always presented greater hazards for persons in the sunset years of life but the hazards are much less today than a generation ago. Although the training and skill of ordinary surgeons today is better than the training and skill of the outstanding surgeons of a generation ago, it would seem that the reduction of mortality is not alone due to increased technical skills. The improvement in mortality rates for elderly persons following operations has not been so much in the reduction of death in the operating room as in the postoperative critical and convalescent periods.

The lowering of the hazards of surgical intervention for elderly patients has resulted from many factors. Innovation of surgical and anesthetic techniques has played a role but the principal benefit of these improvements so far as patients are concerned is that they permit more adventurous surgical procedures. Early ambulation also has been helpful. However, the major factors in decreasing the hazards of operation have come and are continuing to come from the research laboratories—first in the form of products with specific medicinal properties and second, but much more important, in the form of information of the many complex physiological processes in health and disease. This latter factor is the key that opens the door to another day for many elderly patients.

In obtaining perspective of the elderly patient, chronological age is unimportant compared with an estimation of physiological age. The degree to which degenerative changes and the scars of previous or continuing disease processes have replaced functioning cells in the organs and tissues of the body is an infinitely greater index of the risk of a surgical procedure than mere age in terms of years. Some of the changes in cellular structure resulting from disease or degeneration are relatively unimportant with regard to risk to the patient during anesthesia and operation, whereas others are of paramount importance, such as those in the cardiovascular system, the respiratory system, the kidneys and the liver.

The cardiovascular system must be singled out primarily as the interchange system of the body. It is the highway that provides the cells with oxygen, without which such organs as the brain, the heart, the kidneys and the liver cease to function; that carries the protein building-blocks and the sugars for the anabolic functions of the cell; that distributes the hormonal components that control cellular activity; that has available the components for the clotting mechanism; and that carries salts so necessary for cellular function.

Disease and degenerative processes may so affect the cardiovascular system that its compensatory mechanisms are weakened. But this does not mean that the patient is to be denied the benefits of surgical treatment. It does mean, however, that the patient with a history of myocardial infarction must have adequate pulmonary ventilation and circulation not only during the operative procedure but also during the convalescent period. It means also that hypertensive patients must be kept in a hypertensive state since a lowering of blood pressure may lead to thrombosis and/or embolism, while a sudden increase in blood pressure may result in a cerebrovascular accident. And it does mean the avoidance of prolonged hypotensive states since the decreased flow of blood deprives such organs as the brain, heart, kidney and liver of an adequate supply of oxygen. Such hypoxia may result in coma, hemi-

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plegia or depression of such vital centers as the respiratory and cardiac centers in the brain, or in cardiac arrhythmia or cardiac failure, or in cessation of function of the kidneys with the resultant piling up of catabolic products in the bloodstream and the loss of the regulatory mechanisms controlling the concentrations of anions and cations in the circulation, or the inhibition of detoxification processes in the liver.

Degenerative processes in the respiratory system are chiefly fibrotic in nature, accompanied by loss of elastic tissue; and very frequently there is some degree of atrophic emphysema. The patient is a respiratory cripple to the degree that those changes are present. The advantages of an oxygen-enriched atmosphere for these patients is obvious, but even more important is the need for adequate ventilation to permit normal gaseous exchange at the alveolar level.

Degenerative changes or the scars of previous disease may leave the kidneys and liver with impairment of function. In these circumstances it is necessary to maintain homeostatic conditions during operation and convalescence, particularly with regard to oxygenation and adequate circulation.

The maintenance of homeostatic conditions in the vascular system necessitates some understanding of water and electrolyte distribution in the body. Water balance in the body represents a balance between intake and output. The kidneys are the main organs concerned with output of water and under normal conditions the kidneys can successfully keep the vascular system within normal or tolerable limits even though there is a large intake of water. However, in the presence of pathological changes such as occur with hypertensive arteriosclerosis, the ability of the kidneys to handle a large intake of water may be impaired and result in edema. Many other disease processes, of course, may produce edema and in each case the edema is the result of lowered osmotic pressure of the circulating plasma accompanied by a decrease in plasma protein. The effect of the diminished osmotic pressure is to reduce the transfer of water from the interstitial spaces to the vascular system, and the effect of the reduced plasma protein is to cause the kidneys to retain water and salts. A vicious circle is instituted.

Water deprivation, on the other hand, is immediately compensated by withdrawal of water from the interstitial spaces. With continuing loss of water from lungs, skin, intestines and kidneys during water deprivation, there is also loss of water from within the cells. The cells respond to this by catabolic processes on the fats, carbohydrates and proteins which break down into water and acid metabolites. The hypovolemia so produced delays the excretory functions of the kidney and the acid metabolites build up in the vascular system as an increase in non-protein nitrogen. Peripheral vascular collapse results from profound hypovolemia.

Complicating the changes in water balance are the changes in electrolytes that are contained in the various water compartments of the body. Sodium is chiefly concerned in the plasma and interstitial compartments, whereas in the cells potassium is the main cation. To a large extent the concentration of sodium determines water balance, since the kidneys try to maintain a normal sodium concentration by excreting or retaining the material. A rise in the sodium concentration stimulates the secretion of antidiuretic substances by the pituitary gland, which stimulates the kidneys to reabsorb water and thus lower the sodium concentration. A fall in sodium concentration stimulates the secretion of steroids from the adrenals, which brings about a reabsorption of sodium by the kidneys to raise the sodium concentration of the blood.

Although potassium is the chief cation of the intracellular space, potassium is also present in low concentration in the plasma and interstitial space. Potassium, unlike sodium, is not adequately retained within the body. As a result, during fasting, vomiting, diarrhea or prolonged gastric suction, the potassium level tends to fall. The signs of hypopotassemia are chiefly cardiac, and characteristic changes in the electrocardiogram take place as degenerative changes proceed in the myocardium. The correction of potassium deficiency must be brought about slowly, for a sudden increase in the potassium concentration in the plasma above a critical point may induce cardiac arrest.

The problems of water and electrolyte balance in elderly patients must be evaluated in terms of the patient's physiological age and whatever pathologic condition is present. Intake of fluid from all sources should not exceed the output by all avenues. Particular consideration must be given to patients with known cardiac disease to prevent overloading of the myocardium by excessive fluid. Special attention must be given also to patients with kidneys that do not concentrate urine and who therefore need proportionately larger volume of fluids to get rid of metabolites. The salt intake is best restricted, except in cases of definite loss, to about 5 gm. of sodium chloride a day to prevent excessive rise in sodium and chloride levels. In addition, sodium and potassium levels are reciprocal and high sodium intake will tend to produce hypopotassemia.

The nutritional aspects of surgical intervention must be recognized, and in elderly persons close attention to nutritional needs is particularly rewarding.

Hypoproteinemia is a major enemy of elderly patients following surgical operation. The loss of

protein may be considerable, resulting from atrophy of disuse, from toxic destruction of protein, from loss by hemorrhage and from protein catabolism to meet caloric needs.

In the preparation of a patient for operation and in the management of him in the postoperative period, it is mandatory that the intake of nitrogen equal or exceed the nitrogen loss. Such a positive nitrogen balance will yield benefits such as better wound healing and decreased incidence of wound dehiscense, greater motility of the gastrointestinal tract, avoidance of edema, greater cardiovascular stability and improved liver function.

The maintenance of a positive nitrogen balance is best accomplished by oral feedings. Where such therapy is contraindicated, parenteral administration must be used. The best substances for parenteral use for this purpose are whole blood, plasma and serum albumin. However, proteins for parenteral administration are also available for maintenance of a positive nitrogen balance.

The carbohydrate intake serves a useful purpose for the patient in supplying basal caloric requirements, but, much more important, carbohydrates protect the patient's protein reserves from catabolic activities. The administration of 100 gm. of carbohydrate in conjunction with parenteral proteins may provide a positive nitrogen balance.

Vitamins are important nutritional aids. Vitamins B and C are rapidly used up by the body. The components of the vitamin B complex are required in large amounts to utilize parenteral glucose. Also, the detoxifying functions of the liver are dependent on vitamins. If there is a deficiency of vitamins, body protein is catabolized to provide the liver with these detoxifying catalysts. In the absence of vitamins, so much protein is destroyed that it is impossible to maintain a positive nitrogen balance.

In the use of anesthetic and analgesic agents on elderly patients, constant vigil must be kept against overdosage. The depression from such overdosage in a patient with cardiovascular disease can impair the functions of the cardiovascular system, particularly in the supply of oxygen to vital centers and organs. Since the heart is one of these vital organs, a vicious circle of further depression of cardiac activity can quickly be started. For patients who are "cardiovascular cripples," hemodynamic stability and abundant oxygen are imperative.

The differing effects of drugs on patients of different physiological age has never received much attention. Yet it is known that the depressant properties of some narcotics are greater in the very young and the aged. Also, it is common knowledge that scopolamine, while possessing a euphoric property for patients in the 20 to 60 age group, may in equivalent doses produce extreme excitement in persons of greater age. In a recent study[1] on the effectiveness of Dramamine in controlling postoperative nausea and vomiting, a difference of effectiveness related to the age of the subject was noted. In patients under 60 years of age, Dramamine reduced the incidence of postoperative nausea and vomiting by about 27 per cent as compared with a control group. But in patients over 60 years of age there was a reversal of effect; the incidence of nausea and vomiting was greater in patients given Dramamine than in the control series.

Ether has long been considered a safe anesthetic agent since very little disturbance of cardiovascular dynamics or of liver and renal function has been observed in connection with its use. However, recent research by Brewster and co-workers[2] showed ether to be a direct depressant of the myocardium in animals, and it was observed that the beneficial effect of ether on the cardiovascular system is due to the sympathomimetic effect of the drug—direct stimulation of sympathetic nerve endings and the adrenal medulla.

In elderly persons the aging process or disease may produce atrophy or depression of the adrenal or pituitary glands, and in such circumstances ether would act only as a myocardial depressant with perhaps fatal results. In the light of these observations, smugness or complacency about the use of ether as the anesthetic of choice in elderly persons is unwarranted. It is possible that other drugs may possess inherent dangers for elderly patients due to differing pharmacological effect with age. If such pharmacological eccentricities exist, it will be up to anesthesiologists as pharmacological clinicians to prove it.

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